

**NEHRU MEMORIAL LECTURE**

**INDIAN AGRICULTURAL STATISTICS RESEARCH INSTITUTE, NEW DELHI**

**LOW COST HIGH SPEED COMPUTER-COMMUNICATION  
NETWORK SUPPORT**

**FOR**

**AGRICULTURAL DEVELOPMENT**

**BY**

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# **LOW-COST HIGH-SPEED COMPUTER-COMMUNICATION NETWORK SUPPORT FOR AGRICULTURAL DEVELOPMENT**

## **I. INTRODUCTION**

In 1995, the National Informatics Centre (NIC) of the Planning Commission, organised in collaboration with the Ministry of Agriculture, Ministry of Rural Areas and Employment and the Department of Fertilizers, a conference on 'Informatics for Sustainable Agricultural Development'. The response from agricultural researchers and statisticians was beyond expectations with more than 200 papers included in the conference. It was one of the largest gathering of agricultural scientists and statisticians on this inter-disciplinary subject in the country. Enthused by this, a number of initiatives are being taken in the interface between informatics and agriculture. An appropriate infrastructure for sustaining these initiatives is already growing. A Low-Cost High-Speed Computer-Communication support through a close user group of NICNET is already on the ground and also in the sky because it is a satellite-based network.

NICNET has already connected the national capital with all the 32 States/UT Capitals and more than 500 District Headquarters. As a network with the largest spatial spread, the services provided by NIC include the development of database systems, Electronic Mail, Geographical Information Systems, access to international databases and now Video Conferencing among others. The main backbone that is evolving is the NICNET National Info Highway. Each node of this highway has around 1 Mbps speed capacity. This year, 1000 high speed VSATs of 64 Kbps at user locations are being installed. NICNET provides one of the most advanced World Wide Web (WWW) server technology utilising BASIS Web Server installed over the highway. A powerful satellite data broadcast facility with very low cost Receive-Only VSATs at user end is also growing.

What benefit such a network can give to the promotion of sustainable agricultural development in the country? What new technologies are emerging and what is their significance to the agricultural sector? What kind of training would be required to make the agricultural scientists, statisticians and extension workers network-literate in addition to being computer-literate? How can we develop the technologies necessary for user friendliness and the ethos necessary for computer-network friendliness? These are some of the issues I would like to dwell upon in the rest of this presentation.

3. At the Aligarh Muslim University, a project supported by NIC is being carried out on the Multiple Database Approach for Sustainable Agricultural Development. This project attempted the concept of Terrain Mapping Units (TMUs) for natural resource informatics. The TMUs are natural entities characterised by homogeneity of lithology, soil type, slope characteristics, ground water conditions and uniformity of landforms, among others. The concept of spatial information system for sustainable agriculture has been proposed by this Group. They are attempting to develop environmentally compatible land management system for agriculture and forestry by developing TMUs as management unit for deciding agricultural inputs and practices instead of District, Tehsil or Block or Village which have artificial boundaries.

4. The Sikkim State Unit of NIC has developed a Sustainable Agriculture Informatics Model with specific reference to meet the problems of gradual degradation of land, water and forest resources in North Eastern Himalayan Region of the country due to increasing demographic pressure. They are working out informatics support for location specific scientific management of land and water resources for sustained productivity. They are supporting the State Government in developing an integrated farming system approach on Watershed concept involving agriculture, horticulture and silvipastoral system. This exercise is highly information-dependant because, over 90 percent of the annual precipitation is proposed to be retained with negligible soil losses. A strong database is found necessary on various aspects including land, water, forests, demographic and geo-morphological features of the region, climatic parameters, agricultural and socio-economic conditions of the farmers, marketing structure, institutional linkages and so on, which inter-alia requires a network-based distributed database system.

5. A NICNET based Agricultural Census Information System has been developed by the Agricultural Census Division of the Department of Agriculture & Cooperation of the Ministry of Agriculture with the support of the Agricultural Informatics Division of NIC. The Agricultural Census provides essential information on a number of operational holdings along with other related characteristics like tenancy status, cropping and land use pattern, irrigation status, among others. The input survey provides valuable information on the consumption of various inputs such as fertilisers, pesticides, manure, agricultural machinery and implements, livestock and flow of credit to agricultural holdings. The software is being implemented at District level with the help of NICNET District Centres which will transmit the results to the concerned State Units and in their turn, to the Central Government for generating national level tables.

6. With the basic information collected, collated and disseminated by the India Meteorological Department (IMD) certain weather related databases and models are being developed by the Met Database Unit at NIC Headquarters with the hope that eventually a NICNET based automatic Met Network would emerge supplementing those of IMD. This is an essential information input to an eventual Farmers' Information System.

7. The assessment of accurate agricultural crop yield is of importance in the country. The methodology has been developed by the GISNIC (Geographical Information System of NIC) Group at NIC Headquarters for predicting the crop yield in advance. The yield calculated from the digital data will be correlated with the meteorological data and finally the agro-meteorological model can be developed by user organisation so as to predict the yield assessment in advance. This data can be transferred to the GISNIC and Maps can be drawn which will be used to assist the decision makers by indicating the places of the high yield to plan the future strategy.

8. In the State of Haryana, the Agriculture Directorates have been collecting, case analysis data of crop cutting experiments so as to assess the average yield per acre and total out-turn of the assessing principal food and non-food crops. About 10,000 experiments in approximately 5000 villages are covered each year. Each experiment contains around 100 data fields. The Haryana State Unit of NIC has been assisting the Agricultural Directorate in computerisation and analysis of this data for wheat and paddy crop experiments. It is proposed to feed the data at district level and transmit through NICNET the relevant information to the State Headquarters for compilation, analysis and helping in decision making.

9. The Horticulture Division of the Department of Agriculture and Cooperation has evolved a NICNET based Executive Support System for effective monitoring of the schemes and developing an exhaustive database for future planning. Online access of databases of area, production, yield, export and price statistics is under way.

10. In Maharashtra, the Western Regional Centre of NIC is assisting the Department of Agriculture, MSSC and MSSA with databases concerning seed supplies as per the demands, targets and seed availability, seed production programme with growers, collection of raw seeds from growers and seed certification. A Close-User-Group on NICNET is being created for strengthening the Seed Informatics throughout the country. This network called, 'SEEDNET' would facilitate dissemination of permitted information at regional, national and international levels. Aspects of Seed Informatics

include perspective planning, market research, project monitoring requirement, production, import-export, allocation, distribution, storage, marketing and quality control of seeds.

11. The Soil Information System Division of NIC has developed a computerised information system for making available 'Soil Series of India' published by NBSS and LUP containing 180 Soil Series all over the country.

12. A NICNET based Integrated Nutrient Management for sustainable Agricultural Development has been developed by the Fertilizer Informatics Division of NIC. An Integrated Information System for Watershed Project utilising databases as well as GIS methodologies are being developed at the Western Regional Centre of NIC at Pune for supporting the projects of Government of Maharashtra. A major project under way is the National Watershed Development Project for Rain-fed Areas (NWPRA).

13. The Agricultural Market Information Dissemination through NICNET has been successfully carried out by the NIC State Units for the respective State Governments in Gujarat, Maharashtra and Haryana.

14. A pilot study of Canara Bank in Madurai District in Tamil Nadu was conducted regarding the informatics for agricultural credits.

15. The Analytic and Modelling Division of NIC Headquarters has developed a Planning Model as well as a Computer-aided Project Management System for guiding sustainable agricultural development.

The 15 cases of NIC-supported developments of Agricultural Information Systems in different areas of agriculture is reasonably representative of the sector. A quick and cost-effective manner of increasing computerisation and networking several folds is simply to horizontally transfer NIC's experience in one State or the Centre to all other States and agricultural organisations. There is no need to develop new software in several areas except to fine-tune whatever has been developed so far to meet the local requirements. Whereas ab-initio software development would require several man-months of effort, the horizontal transfer approach would reduce the time by an order of magnitude.

In addition, NIC has prepared a Master Plan for the next three years for the development of 16 Closed-User Group-(CUG) networks of NICNET for each major area in the agricultural sector. The Agricultural Informatics Division of NIC is in the

stage of designing these 16 networks and implement the same over NICNET to a strict time bound schedule.

FERTNET	Fertilizer Informatics Network
APHIN	Animal Production and Health Informatics Network in India
HORTNET	Horticulture Informatics Network
PPIN	Plant Protection Informatics Network
VISTARNET	Agricultural Extension Informatics Network
ARISNET	Agricultural Research Information System Network
CROPSNET	Crops Informatics Network
FISHNET	Fisheries Informatics Network
SEEDNET	Seed Informatics Network
ACIN	Agricultural Credit Informatics Network
AGRIMKT	Agricultural Marketing Intelligence Informatics Network
AgriES	Agricultural Economics & Statistical Informatics Network
LISNET	Land Information System Network to strengthen Soil, Water and Nutrient Management Research and Development in India
NDMNET	Natural Disaster Management Network in India
MISTNIC	Meteorological Information Services Terminal of NICNET

All the above CUG networks will be designed as virtual networks over NICNET so that the user departments not only have total access of NICNET nodes but also keep any information confidential or for controlled dissemination as required. NIC will train receptive people in each user organisation so thoroughly that they should be in a position to take care of the day-to-day operations of the CUG virtual network by themselves and keep updating the databases on their own initiative. In this way, NIC will confine itself to the role of a proactive facilitator. It will have no right over information which will entirely be the property of the user organisation. Whatever information is declared open by them or by issuance of Password to designated users, the NIC will disseminate over NICNET. This is an essential policy instrument of NIC to elicit maximum cooperation from the user organisations.

## II. DISTRIBUTED NETWORK FOR DISTRIBUTED INFRASTRUCTURE

Agriculture is a widespread activity spatially. Its dynamics is based on a multi level hierarchy of delegations of power to implement. Necessarily the informatics problems of agriculture would require the backbone of a distributed computer-communication network like NICNET. The system is highly dynamic and interactive. It

is dynamic because it changes seasonally and during monsoon and harvest seasons. They are interactive because decision making at any location would require information inputs from a number of other peers as well as from higher ups in the hierarchy. Both these require a vibrant computer-communication network which can be relied upon at all times. New technologies are being introduced at an exponential pace. For realising a low-cost and yet quality infrastructure, one has to make a proper choice of technologies. Such computer-communication technologies can effectively solve our types of problems only if there is a major R&D and system engineering support specialising in Information Technology - both computer and communication hardware and software. It is here that NIC has an intrinsic role.

### III. EMERGING TECHNOLOGIES IN COMPUTER-COMMUNICATION

I will briefly describe some of the emerging computer communication technologies which we have identified as beneficial to the Indian agricultural sector.

#### A. Computer Hardware:

1. Pentium Pro, Septium and Beyond: With the coming of 200 MHz Pentium Pro, the gap between the Intel Chips and RISC chips is bridging faster. Over the past 15 years, NIC had standardised on Intel Chips of the X86 series with 586 currently running and 686 on the anvil. The Pentium/Septium is expected to cross the stupendous speed of 250 MHz during the course of this year. For many of the applications, a diminishing return of further speed can be expected. The prices of chips and PCs is fast reducing. For the same capacity the prices are halving every two years. The colossal memory and disk capacities of the order of 64 MB and 4 GB respectively are getting available at the same price as half this capacity was price tagged just a year ago.
2. Network Computers: In the Client-Server architectures of computers, it is now possible to have a weak client addressing a strong server, thanks to such software innovations as JAVA and HTML as well as the very low price tag of less than \$ 600 for client computer. Low end, low cost network computers are dependant on such systems as CITRIX WINFRAME to perform all functions as the network computer without native JAVA. JAVA capable network computers may cost about \$ 900

and require a significantly faster processor. Microsoft is building a remote multi-user capability into the NT server natively. Though this will be good for the end user, it may badly affect CITRIX systems and those systems which are dependant on its WINFRAME package. Microsoft's Zero Administration Window is likely to be the software that would allow their Net PC to function like a network computer.

The Network computer ARENA is bounded by PCs at one end and dumb terminals at the other. There is a vast space in between these two ends with different capacities of clients with the network computer targetting X terminals, Kiosks, ATMs, Retail terminals and a variety of the consumer devices. JAVA and INTERNET access are getting added to the X Terminals. In this environment, Window's applications are separated by a remote NT server product (CITRIX WINFRAME).

## **B. Computer Software**

A veritable software war is raging in the international software market scene. On one side Microsoft is championing PCs with Windows like NT and Window 95. In the Client Server architecture, they represent strong clients and relatively weak servers. At the other end is the intrinsic JAVA enabled HTML - actuated with thin clients getting everything done from strong servers. The JAVA revolution was triggered by the development of an environment where the developer can create applications that run on all major operating systems. It is the most important software development package to appear in this decade. Everyone is tying their operating system with JAVA - Microsoft with its NT and SCO with its UNIX. The developer who uses JAVA to create portable applications can distribute them on either SCO Client-Server system or NT Client-Server system. Wherever there is a large population of terminals - for example, NIC has 15,000 of them - UNIX cannot be avoided. At the same time, the new realities like Windows Programming using NT and Window 95 have to be accommodated in the network. This is what is being done by a judicious combination of Client-Server architecture and network computers using JAVA and HTML. Competition is mounting. For example, to give continuity to UNIX, SCO has fielded 'TARANTELLA' which dramatically increases the benefits of JAVA clients using UNIX. TARANTELLA underscores a commitment to the new INTERNET way of computing. It provides JAVA clients running web browsers with access to graphical X applications, character based UNIX applications and UNIX SQL - Data across the INTERNET. The applications run instantly eliminating the costly applications



of Re-Writes. The applications are seamlessly embedded within the Web Browser along side HTML text and graphics. Similar innovations are being done by Microsoft with its NT Workstations and NT Servers.

### **C. Object Oriented Programming**

The last few years has seen a paradigm shift towards Object Oriented Programming. The software is developed in terms of certain defined objects, which are natural to the application environment. Here again, JAVA shows the way. JAVA is the next step to C++. Since the country missed C++ stage by and large, it is prudent now to jump from C Orientation to JAVA directly. This is what NIC is doing now. Again, the same Object Orientation guides the choice of the RDBMS. At this point in time, if we want to choose an RDBMS, there are numerous advantages of choosing one which has been entirely designed with Object Oriented Programming. This is the reason for one of the recent standardisation of RDBMS by NIC around the Multimedia DB/2 of IBM along with its other associated software like LOTUS Notes, Visual Age+ and Smart Suite.

### **D. Geographical Information System**

Most applications in agriculture would require this. But the software is very costly running to more than a Lakh of Rupees per copy. It is for this reason that NIC put in considerable R&D efforts to develop its own GISNIC whose latest version is almost as powerful as the world famous ARC/INFO. Now we are spreading the GIS in all the 500 and odd Districts. Here again, NIC has given low cost solution of service to agricultural scientists, statisticians and extension workers. An important aspect of NIC's GIS is the spatially distributed database structure which is possible to be operated over NICNET with considerable facility.

### **E. Data Communication**

NIC has broadly divided its communication infrastructure into INTRANET and INTERNET - both are based on INTERNET Protocol and hence there is very good compatibility.

**INTRANET:** It was realised that the INTERNET technology and the Web Protocol can be harnessed to build the Web Server based network within

the organisation and do away with multi-platform, multi-protocol connectivity issues. What NIC is doing over NICNET is to bring about a national INTRANET. The advantages of INTRANET can range from cost-effectiveness to speeding up communication. Communication, collaboration and distributed applications are the main areas where INTRANET technologies influence the user implementation. The INTRANET building blocks are again, Web processor, TCP/IP protocol, Hyper Text Transmission Protocol (HTTP), Web Server, CGI (Common Gateway Interface), HTML (Hyper Text Mark Up Language), Authoring tools, among others.

**INTERNET:** INTERNET is the harbinger of a global market beyond borders, beyond barriers, beyond boundaries and beyond mind-sets. Tens of thousands of databases are available around the world, many of them for free access. No country can afford not to benefit by these. INTERNET connection however, requires a very open gateway regime. This cannot be controlled by one organisation. It is for this reason that NIC had put up a major proposal for the Cabinet which has since been approved for making NICNET independent of DOT and VSNL for giving the benefit of INTERNET and INTRANET without avoidable control to all promotional applications of national importance. That includes the entire agricultural sector. We want to maximally spread the INTERNET culture among agricultural scientists and statisticians, because, in our estimate, there are more than a thousand databases up there in INTERNET for you to tap.

**F. Data Broadcast:** Data broadcast has been introduced by us using low cost Direc PC VSAT terminals. This can give not only Web access for heavy down loading applications, but also broadcasting meteorological and other information daily to the farmers on a strict time targeted dissemination basis.

**G. Video Conferencing:** With our own R&D in hardware and software superposed on imported knowhow, we have developed a low cost Video Conferencing facility. We are creating VIDCON Studios in about 70 cities. So far we have reached 20. We hope that by Mid 1998, all 70 cities would be covered. For Video Conferencing between two cities over NICNET would cost you only Rs. 3600 per hour. Five or six of you travelling from one city to another, would cost you almost a lakh of Rupees. Imagine the enormous cost saving that Video Conferencing can give. We have decided to take up a few dozen VIDCON Sessions for the agricultural sector this year, especially

between the Ministry in Delhi and the various agricultural units. Later, we will spread the culture far and wide.

**H. MBONE:** Capping ALL this is the technological marvel of MBONE. It is the international Video Conferencing over broad-band INTERNET. NIC is a member of the international MBONE Club. We are hoping to give the MBONE video-broadcast services from all over the world to our users by the end of this calendar year.

There are many more technologies of interest to the agricultural community including facilities over NICNET for distance education and distance awareness services. Suffice to mention that we are constantly monitoring the emerging new technologies and we hope to keep abreast of these trends superposing our own R&D. We will be ready with these facilities almost at the sametime as developed countries like USA and UK. We look forward to the agricultural sector transforming very fast towards the Information Age and we hope to be one of the catalysts in this transformation